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Beak marks on the wings of Japanese noctuid moths and satyrine butterflies (Lepidoptera, Noctuidae, Nymphalidae)

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Abstract In the present paper, I describe 27 beak-marked specimens from 15 species of Japanese noctuid moths and two satyrine butterflies. The most characteristic beak-damage pattern in Noctuidae is two tears on the same side of fore- and hindwings. They correspond to an overlapping position of the closed wings while the moth is resting. The attack by a bird might occur only once. Some moths had beak-mark only on their hindwings. These cases are thought to be due to moths opening their wings before flying to threaten an enemy. Apparently birds were attracted by their hindwing pattern to attack. It was estimated that about 20 to 40% of moths coming to light traps had experience of escape from the attacks by birds.

The symmetrical beak-damage patterns on both forewings or on both hindwings are characteristic in the butterflies studied, and never seen in moths. The butterfly is attacked while resting with its wings closed.

Key words Beak mark, moths, Noctuidae, butterfly, Satyrinae of Nymphalidae.

I found 29 beak-damaged specimens in my collection of Japanese moths and butterflies. Among them, 27 specimens belong to 15 species of two subfamilies (Catocalinae and Calpinae) of the family Noctuidae. The Catocalinae is represented by seven species of the genus *Catocala*, and one species each of the genera *Ophiusa*, *Ophisma*, *Achaea* and *Artena*. *Catocala* occurs in temperate forests. The cryptic pattern of their forewings resembles that of tree bark, but on their hindwings there is a red, yellow or white pattern on a black ground color. In contrast, the distributions of the other four genera are rather subtropical or tropical.

Their color patterns on the fore- and hindwings resemble those of moths belonging to the subfamily Calpinae.

In the subfamily Calpinae, beak marks were found in four species—*Othreis homaena*, *Adris tyrannus*, *Eudocima salaminia* and *Serrodes campana*. The distributions of these species are subtropical or tropical. The pattern of their forewings mimics dead leaves. Their hindwings have a comma-shaped heraldic design on a yellow ground color, except *S. campana*.

The two butterfly specimens both belong to the subfamily Satyrinae of the family Nymphalidae.

In the present paper, I illustrate all the beak-marked specimens and discuss the cause of each case of wing damage.

List of beak-damaged specimens

The position of the beak mark is represented as follows: F=Forewing, H=Hindwing, R=Right, and L=Left. For example, it is described as RF when the right forewing only was damaged. If the right forewing and left forewing were damaged, it is described as RF+LF.

In a case where all four wings were damaged, it is denoted as RF+RH+LF+LH.

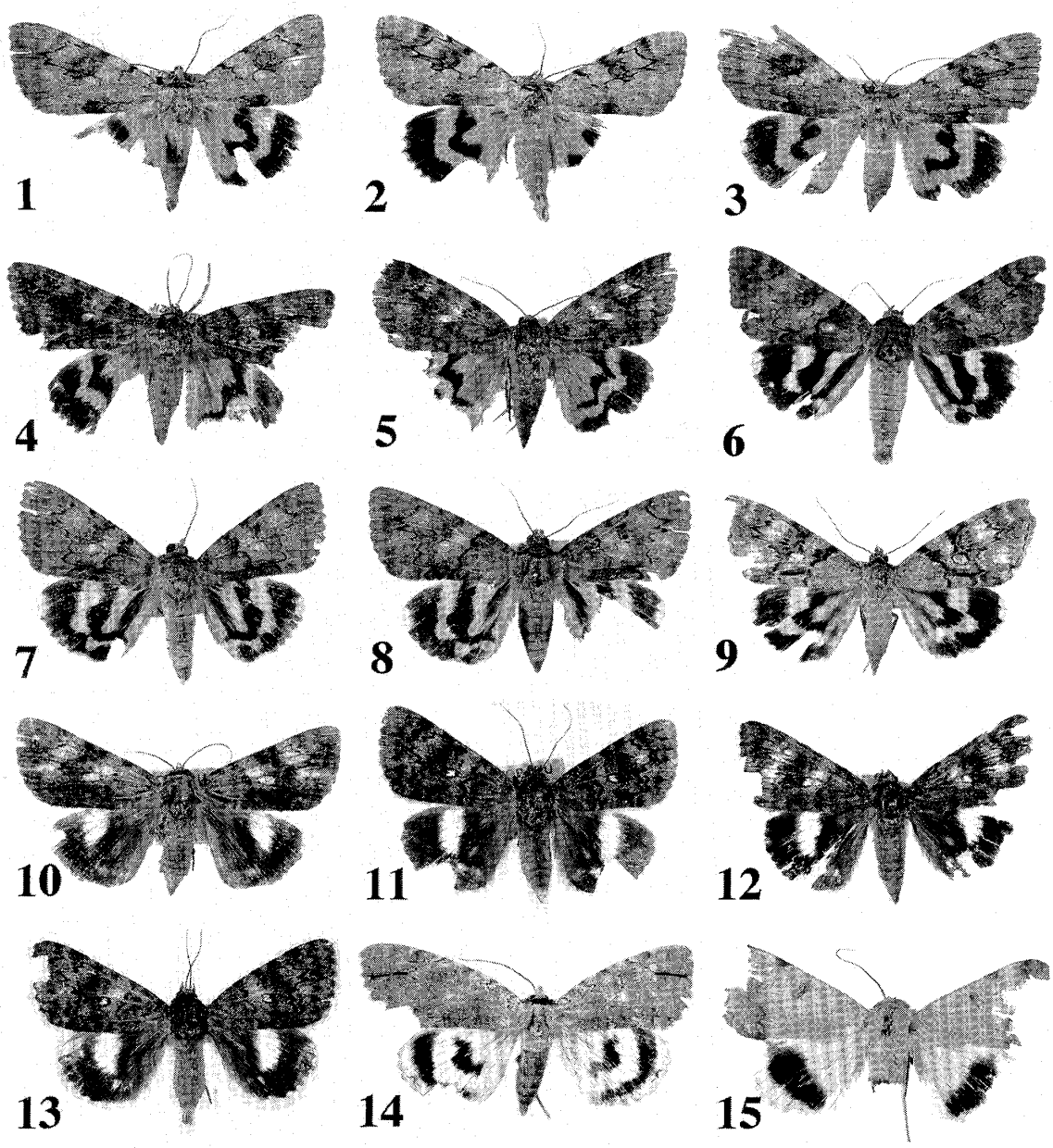
Four specimens figured have broken abdomen ends (Figs 15, 22, 24 and 26): these were not due to attack by birds, but to my having cut them off to prepare genitalia specimens.

Family Noctuidae
Subfamily Catocalinae

1. *Catocala electa* ベニシタバ
   1 ♂ (Fig. 1), RH+LH. Jizobaru, Kokonoe, Oita-pref., 30. viii. 2001, Coll. A. Miyata; 1 ♂ (Fig. 2), RH+ LH. *Ditto*, 30. viii. 2002, Coll. A. Miyata; 1 ♂ (Fig. 3), RF+RH+LF+ LH. *Ditto*, 20. ix. 2003, Coll. A. Miyata.
2. *Catocala dula* オニベニシタバ
   1 ♂ (Fig. 4), RF+RH+LF+LH, 1 ♂ (Fig. 5), RH+LF+LH. Jizobaru, Kokonoe, Oita-pref., 15. ix. 2001, Coll. A. Miyata.
3. *Catocala patala* キシタバ
   1 ♂ (Fig. 6), RF+LF+LH. Hazama-cho, Oita-pref., 22. vi. 1980, Coll. A. Miyata; 1 ♂ (Fig. 7), LH. Jizobaru, Kokonoe, Oita-pref., 19. viii. 2003, Coll. A. Miyata; 1 ♂ (Fig. 8), RH. *Ditto*, 15. viii. 2003, Coll. A. Miyata.
4. *Catocala jonasii* ジョナスキシタバ
   1 ♂ (Fig. 9), LF+LH. Shiiyatoge, Kumamoto-pref., 30. vii. 1986, Coll. K. Yoshizaki.
5. *Catocala nagioides* ヒメシロシタバ
   1 ♂ (Fig. 10), LF+LH. Jizobaru, Kokonoe, Oita-pref., 15. ix. 2001, Coll. A. Miyata.
6. *Catocala actaea* コシロシタバ
   1 ♂ (Fig. 11), RH+LH. Hashizu, Usa City, Oita-pref., 18. viii. 1980, Coll. M. Nakajima; 1 ♂ (Fig. 12), RF+RH+LF+LH. Shinyabakei, Oita-pref., 11–12. ix. 1982, Coll. A, Miyata; 1 ♂ (Fig. 13), LF. Jizobaru, Kokonoe, Oita-pref., 15. ix. 2001, Coll. A. Miyata.
7. *Catocala nivea* シロシタバ
   1 ♂ (Fig. 14), LF+LH. Sugadaira, Nagano-pref., 17. viii. 1970, Coll. Y. Kobayashi.
8. *Ophiusa tirhaca* クロモンシタバ
   1 ♂ (Fig. 15), RF+RH+LF+LH. Kogakura, Nagasaki City, 5. xi. 1973, Coll. A. Miyata.
9. *Ophisma gravata* キモンクチバ
   1 ♂ (Fig. 16), RH. Funaura, Iriomotejima, Ryukyu, 6. vii. 1978, Coll. A. Miyata.
10. *Achaea serva* オオシラホシアシブトクチバ
    1 ♂ (Fig. 17), LF+LH. Takarajima, Tokara Islands, 25–30. vii. 1975, Coll. A. Miyata.
11. *Artena dotata* ツキワクチバ
    1 ♀ (Fig. 18), RH. Jizobaru, Kokonoe, Oita-pref., 8. ix. 2002, Coll. A. Miyata; 1 ♂ (Fig. 19), RH. *Ditto*, 29. viii. 2003, Coll. A. Miyata; 1 ♀ (Fig. 20), LF. *Ditto*, 30. xi. 2003, Coll. A. Miyata.

Subfamily Calpinae

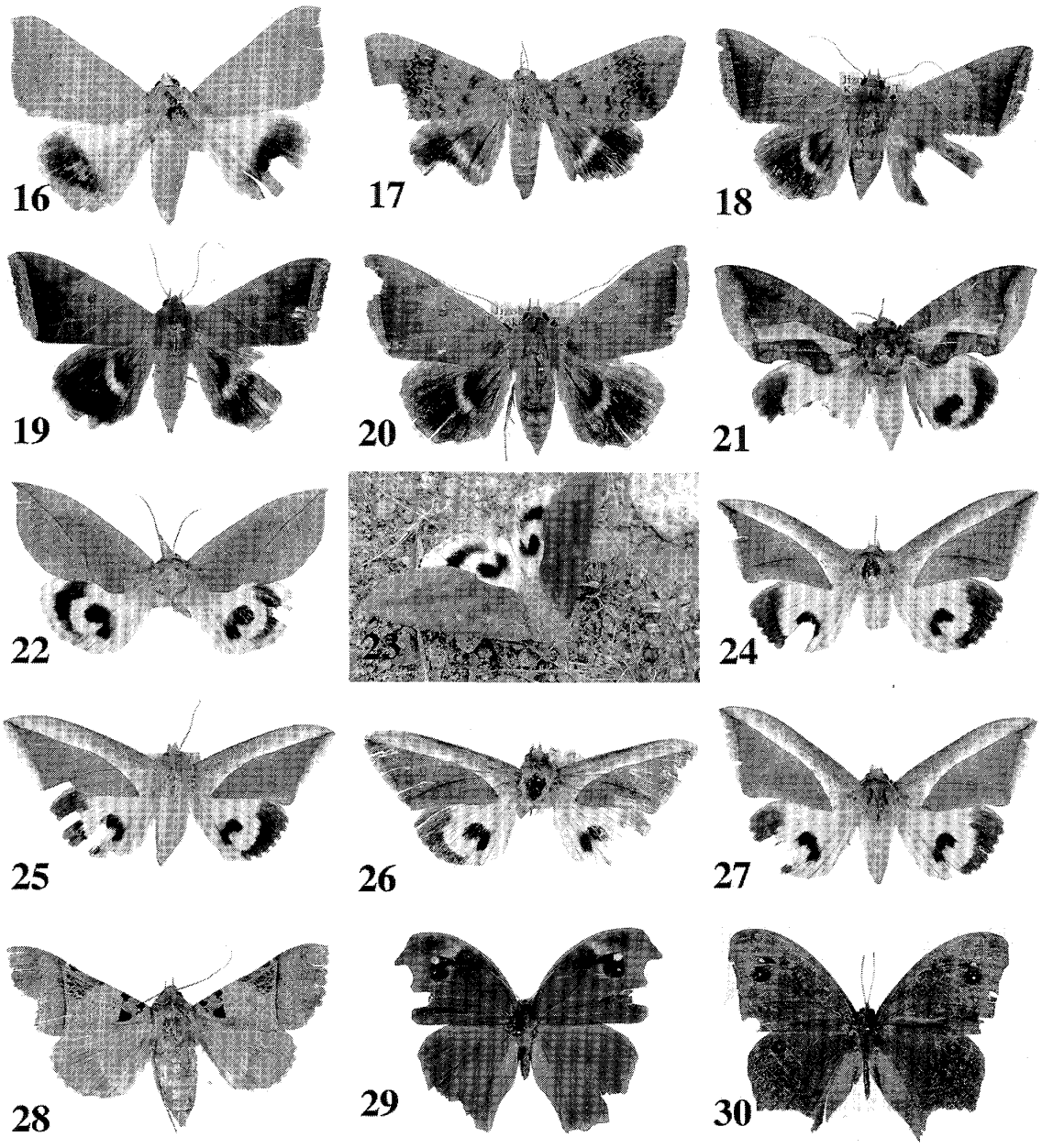
12. *Othreis homaena* ミドリモンコノハ
    1 ♀ (Fig. 21), LH. Mt Bannadake, Ishigakijima, Ryukyu, 15. vi. 1983, Coll. S. Imasaka.
13. *Adris tyrannus* アケビコノハ
    1 ♂ (Fig. 22), RH. Okinoshima, Fukuoka-pref., 24–25. vii. 1978, Coll. A. Miyata.
14. *Eudocima salaminia* キマエコノハ
    1 ♂ (Fig. 24), LF+LH. Maegomori, Takarajima, Tokara Islands, 1. viii. 1975, Coll. A. Miyata; 1 ♂ (Fig. 25), LF+LH. *Ditto*, 3. viii. 1975, Coll. A. Miyata; 1 ♂ (Fig. 26), RF+ RH. Takarajima, Tokara Islands, 3. viii. 1975, Coll. A. Miyata; 1 ♂ (Fig. 27), LH. Funaura, Iriomotejima, Ryukyu, 1. vii. 1978, Coll. A. Miyata.
15. *Serrodes campana* ネジロフトクチバ
    1 ♀ (Fig. 28), LF. Mt Ryozen, Oita City, 31. v. 1980, Coll. A. Miyata.



Figs 1–15. Beak-marked specimens of *Catocala* (1–14) and *Ophiusa* (15). 1–3. *Catocala electa*. 4–5. *C. dula*. 6–8. *C. patala*. 9. *C. jonasii*. 10. *C. nagioides*. 11–13. *C. actaea*. 14. *C. nivea*. 15. *Ophiusa tirhaca*.

Family Nymphalidae
Subfamily Satyrinae

16. *Melanitis phedima oitensis* クロコノマチョウ
1 ♀ (Fig. 29), RF+RH+LF+LH. Hazama-cho, Oita-pref., 11. ix. 1991, Coll. A. Miyata.
17. *Melanitis leda ismene* ウスイロコノマチョウ
1 ex. (Fig. 30), RF+RH+LF+LH. Takarajima, Tokara Islands, 25–30. vii. 1975, Coll. A. Miyata.



Figs 16–30. Beak-marked noctuids and satyrines. 16. *Ophisma gravata*. 17. *Achaea serva*. 18–20. *Artena dotata*. 21. *Othreis homaena*. 22–23. *Adris tyrannus*. 24–27. *Eudocima salaminia*. 28. *Serrodes campana*. 29. *Melanitis phedima oitensis*. 30. *M. leda ismene*.

Discussion

Among the 27 beak-marked specimens of 15 species of moths, four had all four wings damaged, RF+RH+LF+LH (Figs 3, 4, 12 and 15). Two individuals were damaged in three wings: RF+RH +LH (Fig. 5), and RF+LF+LH (Fig. 6). Three specimens had damage to RH+LH (Figs 1, 2 and 11). These multiple damaged specimens might have been attacked more than twice, but it is difficult to analyze the cause of the damage.

The four specimens having beak marks on one forewing and one hindwing were all LF+LH (Figs 9, 14, 17 and 25). If the damages of the left wings were ignored, Figs 3 and 4 might

be classified as RF+RH. In contrast, RF+LH or RH+LF were never observed. These results are noteworthy because damage to the wings on the same side such as RF+RH and LF+LH indicate that birds might attack the resting moths only once from behind. The positions of the damage on the forewing and the hindwing correspond with the resting posture of moths. Sargent (1973) classified these cases into his Type II, which indicates an attack while the moth is resting; the characteristic damage consists of corresponding tears from the overlapping ipsilateral forewing and hindwing when the wings are fully closed. The cases of LF+LH are twice as frequent as RF+RH. This indicates that the bird might use its beak more skillfully to pick up the left side of the wings.

Apparently the bird chooses to attack the hindwing rather than the forewing as shown in Figs 1, 2, 3, 5 and 8. However, these moths came to light trap and their flight was no different to normal moths belonging to the same species. I believe that the attacker discovered a resting moth on a tree stem, and then just before attacking, the moth opened its wings to threaten the enemy with its hindwing pattern. The bird might attack instantly at the moment it saw the pattern, and then the moth might take flight immediately to escape. The bird might pursue the moth and attack its hindwing repeatedly as shown in Figs 1 and 2.

Sargent (1973) classified damages shown in Figs 7, 8, 13, 18, 19, 22, and 24 into his Type I. According to his opinion, the bird attacked while the moth was in flight, and the characteristic damage in this type is unilateral, and involves a tear from one wing only.

I observed some moths opening their wings to threaten an enemy as shown in Fig. 23. This picture was taken in the early morning in late autumn at the garden of Kokonoe Institute of Natural History. *Adris tyrannus* is a rather large moth and without warming up it cannot fly under low temperatures. I observed the same behavior in *Lagoptera juno* whose hindwing has a typical eye pattern with red and blue color. It opened its wings and almost stood on end. I believe that damages to *Eudocima salaminia* were also due to the same cause. From my experiences in tropical countries, large moths such as Sphingidae usually cannot fly in the early morning without warming up. I have not observed the same threat behavior in the moths of the genus *Catocala*, but apparently birds were attracted intensely to their hindwing pattern as shown in Figs 1–5.

Two butterflies also had beak marks caused by birds (Figs 29 and 30). The damages on the forewings of *Melanitis phedima oitensis* (Fig. 29) apparently fall into Joki's 'symmetrical damage' (Joki, 1985). These damages are typical for the butterfly resting with its wings closed and erect. The damages on the hindwings of *Melanitis leda ismene* can be classified as symmetrical damage. These two specimens had other damages that are small but rather symmetrical. These might be caused by bird attack at a different time.

Usually damaged specimens are not preserved as a collection except rare species. However, these are rather uncommon moths in the Kyushu area. Therefore, when I found them, I always kept them for my collection. I caught ten individuals of *Artena dotata* throughout my life as an entomologist, and three specimens (30%) had beak marks. In the case of *Eudocima salaminia*, four (40%) out of 10 specimens had beak marks on their wings. In the genus *Catocala*, two (about 30%) out of 7 *C. dula* specimens, and three (about 20%) out of 16 *C. electa* specimens had beak marks. It might be concluded that about 20 to 40% of moths coming to light trap had experience of escape from attacks by birds.

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Literature

Johki, Y., 1985. Wing damages of butterflies and birds' attacks. *Tyô Ga* **35**: 202–207.

Sargent, T. D., 1973. Studies on the *Catocala* (Noctuidae) of southern New England. IV. A preliminary analysis of beak-damaged specimens, with discussion of anomaly as a potential anti-predator function of hindwing diversity. *J. Lepid. Soc.* **27**: 175–192.

摘　　要

日本産ヤガ科とジャノメチョウ類の翅のビーク・マーク (宮田　彬)

50年にわたり収集した標本を整理中に, ビーク・マークのついたヤガ科の標本が15種27例, ジャノメチョウ類2種2例見つかった. ヤガ科のうち7種14例は*Catocala*属の蛾で, 残りはシタバ亜科の4属4種6例とクチバ亜科の4属4種7例であった. ヤガ科の場合, 鳥の攻撃により出来る最も特徴的な傷は同じ側の前翅と後翅に一つずつ合計二つ見られ, 翅の位置を静止時の形に戻すと前・後翅の傷が重なることから, 静止時に攻撃を受けたことが分かる. また後翅だけに傷を受けている例も多く, このような傷は攻撃直前に蛾が翅を開いて後翅の斑紋を敵に見せて威嚇した結果, 生じたものらしい. 明らかに後翅の斑紋が, 鳥の攻撃をそらし, 生存率を高めていると考えられる. 筆者は*Catocala*が静止したまま後翅を示して敵を威嚇するかどうか未観察である. しかしアケビコノハやムクゲコノハは後翅を開いて後半身を持ち上げるような姿勢をとり威嚇することを観察している. おそらくキマエコノハの後翅の傷は威嚇中に後翅に攻撃を受けたものと思われる. 今回ビーク・マークが見つかった蛾は, いずれも九州では個体数が少ない種である. そうでなければ翅が破損している蛾をわざわざ展翅することはない. それゆえ一部の種では, 今まで出会った総個体数に対するビーク・マーク出現率を計算することが出来た. その結果, 灯火に飛来する蛾のうち20%から40%は, 鳥の攻撃から生還した経験を持っていると推定された. ジャノメチョウ類2種の傷は, 左右の翅に生じた対称傷で, この場合も翅を背中で閉じている状態で鳥の攻撃を受けたことを示している.

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